Factors Affecting CO_2 Emissions from Passenger Cars

Summary

In this proposal, the yearly changes in CO_2 emissions from passenger cars driving were analyzed in terms of three factors: fuel efficiency performance, number of owned vehicles, and travelled distance. As a result, the trend of decrease in CO_2 emissions during 2002 through 2016 could be explained as a whole in terms of a certain amount of effect of the improved fuel efficiency performance on reducing CO_2 emissions, after taking into account the variation in travelled distance, while the effect of increases in the number of owned vehicles has been canceled out. On the other hand, in the analysis of the vehicle lifetime, it was found that the duration for buying a replacement became longer. It can be said that this is rational from the viewpoint of reducing CO_2 emissions because a reduction in CO_2 emissions at the time of vehicle manufacture can contribute to a reduction of CO_2 emissions throughout the lifecycle. Moreover, in the analysis of a model of user's vehicle selection, it was shown that users' satisfaction of fuel efficiency performance was probably close to saturation.

Proposals for Policy Development

- In addition to conventional measures to promote eco-cars that target the reduction of CO_2 emissions during driving, policies that motivate the reduction of CO_2 emissions during manufacturing are desirable. For users whose annual travelled distance is short, buying a low fuel consumption vehicle for replacement does not necessarily contribute to a reduction in CO_2 emissions throughout the lifecycle, and so there is room for consideration of an amendment to the automobile taxation system, amounting to heavy taxation over the years.
- In order to reduce CO_2 emissions arising from a rebound in travelled distance owing to the spread of low fuel consumption vehicles, it is necessary not only to upgrade vehicles to fuel-efficient ones, but also to introduce a policy applicable for vehicle driving, such as fuel taxation.
- Recently, a trend of decline in users' preference to fuel efficiency performance over the years is recognized. To predict policy effects, it is effective to design policies by taking into consideration changes in users' preferences.

1. Breakdown of factors affecting CO_2 emissions from passenger car driving

The yearly changes in CO_2 emissions from 2002 through 2016 are shown in the amount of itemized contribution of fuel efficiency, traveled distance, and number of owned vehicles (Fig. 1). CO_2 emissions were almost on a declining trend, especially in the 2000s. Improved fuel efficiency contributed to the yearly reduction of the emissions by 0.5 to 1 million tons, but on the other hand, increases in the number of owned vehicles increased emissions.

2. Analysis of service life for vehicles

According to recent data, the service life for vehicles is increasing for the engine displacement range of no more than 2,000 cc, which offsets the CO_2 emission reduction benefits of improved fuel economy from vehicle upgrades. On the other hand, longer service life will contribute to reductions in CO_2 emissions throughout the lifecycle if CO_2 emissions during vehicle manufacturing are reduced. Vehicle updates to a small vehicle with excellent fuel efficiency and its use for a long time is needed. Meanwhile, it was suggested that purchases of low fuel consumption vehicles might result in an increase in traveled distance, giving rise to a rebound in CO_2 emissions.

3. Model of user's vehicle selection

User's vehicle selection was analyzed in the use of a model developed based on utility theory. While the preference for fuel efficiency gradually decreased, users who think positively about fuel efficiency were still predominant.

4. Trend of CO_2 emissions from passenger cars

The CO_2 emissions of the entire vehicle fleet were calculated by adding the CO_2 emissions during driving to the CO_2 emissions at the time of vehicle manufacturing. In addition to the results through 2016, CO_2 emissions from 2017 through 2030 were estimated by way of linear extrapolation (Fig. 2). From the extrapolated CO_2 emissions in 2030, for which the specific reduction of emissions is targeted under the Paris Agreement, it was estimated that the CO_2 emissions from passenger cars may fall by about 38% compared to 2013. The 2030 emissions reduction target for transportation as a whole under the Paris Agreement is 28% compared to 2013; this means that the contribution of passenger cars for the achievement of the target is significant.

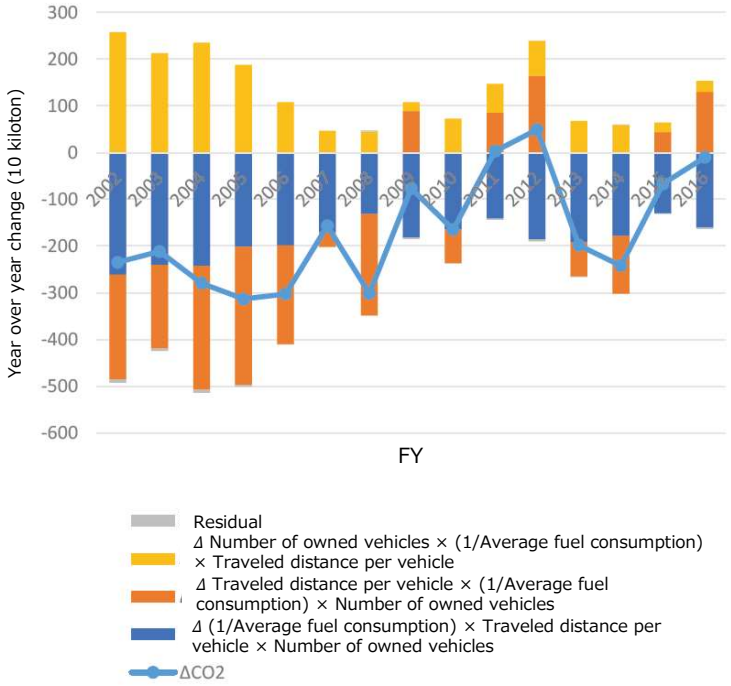

Fig. 1 Breakdown of factors affecting CO_2 emissions from passenger cars

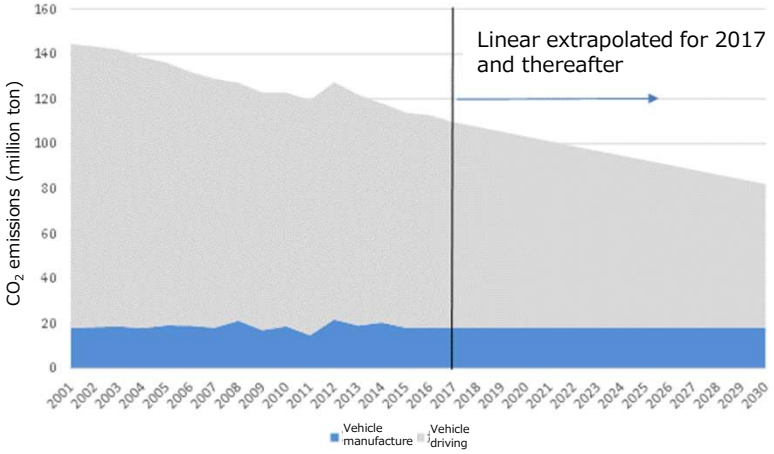

Fig. 2 Changes over the years in CO_2 emissions at the time of vehicle manufacture and during vehicle driving